

## PATENT ABSTRACTS OF JAPAN

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JAPAN TECHNO CO.,LTD

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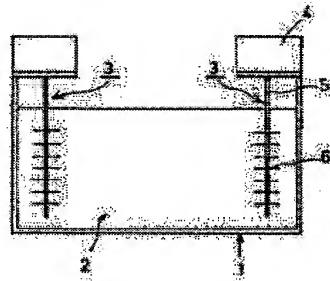
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## (54) METHOD FOR QUENCHING STEEL AND APPARATUS THEREFOR

## (57)Abstract:

**PROBLEM TO BE SOLVED:** To reduce the number of times of exchanging quenching oil and to save time loss in exchanging work by executing quenching while dipping a steel into the quenching oil applied vibration.

**SOLUTION:** The quenching oil 2 is made to flow into a quenching vessel 1 and further, vibration stirrers 3 are set at both ends in an inner part of the quenching vessel 1. The vibration stirrer 3 transfers the vibration generated desirably with output of low frequency, such as 10-500 Hz into an almost horizontal state multi-stop type vibrating blades 6 and a high speed three-dimensional turbulence is developed in the quenching oil 2 with the vibration. In this stirring, entrainment of air or the like, is not developed and bubbles are not developed. In this result, cooling and the quenching two a hole surface of an article to be treated, are uniformly executed without being affected by shape and dimension of the article to be treated. Further, since the number of times of exchanging the quenching oil 2 matching to the articles to be treated can be reduced and the time loss in the exchanging work can be saved, the efficiency of the quenching work is promoted.



## CORRECTION

[Date of Correction] 15.04.2002

[Applicant] [PAJ ORIGINAL] NIPPON TECHNO KK

[CORRECTED] JAPAN TECHNO CO.,LTD

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CLAIMS

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## [Claim(s)]

[Claim 1]A hardening method of steel hardening by immersing steel into quenching oil which gave vibration.

[Claim 2]A hardening method of the steel according to claim 1, wherein pitch given to quenching oil is 10-500 Hz.

[Claim 3]A hardening device of steel consisting of an oscillating agitator formed in said hardening tub in order to carry out oscillating stirring of quenching oil supplied in a hardening tub and this hardening tub, and this quenching oil.

[Claim 4]A hardening device of the steel according to claim 3 characterized by coming to provide two or more oscillating agitators in a hardening tub.

[Claim 5]A hardening device of the steel according to claim 3 or 4 providing an oscillating agitator with an oscillation generating part, and making a vibration portion generate 10-500-Hz vibration.

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[Translation done.]

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## DETAILED DESCRIPTION

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### [Detailed Description of the Invention]

#### [0001]

[Field of the Invention] This invention relates to the hardening method of steel and equipment using quenching oil in detail about the hardening method at the time of the heat treatment of steel, and its equipment.

#### [0002]

[Description of the Prior Art] In the carburization hardening treatment of steel, etc., hardening is performed, after heating and holding steel to a predetermined temperature and aiming at carburization and diffusion. After heating steel (it is called the following "processed article") more than A3 transformation point and making it a uniform austenite texture, this hardening is performed in order to quench and to obtain martensitic structure. Conventionally, said hardening is mainly performed by an oil, salt, and the gas cooling method.

[0003] Although cooling by said oil has high refrigeration capacity and being excelled in the quenching effect, According to the form and the size of a steel type or a processed article, selection use of the hot oil, semi-hot oil, and cold oil etc. needed to be carried out, therefore quenching oil needed to be changed by a steel type, form, a size, etc. of said processed article. In order to heighten refrigeration capacity conventionally furthermore, stirring quenching oil by stirring wings etc. is performed. Here, a hot oil is equivalent to three sorts of oils in JISK2242, a semi-hot oil is equivalent to two sorts of oils, and a cold oil is equivalent to one sort of oils.

#### [0004]

[Problem to be solved by the invention] In changing quenching oil according to the form and the size of said steel type or a processed article, In the clearing work of this quenching oil taking trouble and time and stirring quenching oil by stirring wings etc. further, It needed to take care that the flow of quenching oil became uneven and inferior goods did not arise, and when the bubble arose and uneven cooling was further performed by stirring wings, there was a case where the hardening quality of a processed article was affected.

[0005] The purpose of this invention is as follows.

The time loss of reduction of the number of times of the clearing work of the quenching oil which it succeeded in view of said situation, could obtain the hardening characteristic comparable as a cold oil even if it was a hot oil, therefore was set by the form and the size of a steel type or a processed article, and clearing work can be excluded.

Furthermore solve problems accompanying stirring of quenching oil, such as cooling unevenness and cooling unevenness according to the steel type or the form, and the size of said processed article further, and provide the hardening method of steel and equipment which aimed at improvement in the hardening characteristic.

#### [0006]

[Means for solving problem] Claim 1 is the hardening method of steel of hardening by immersing steel into the quenching oil which gave vibration. A means to give vibration to said quenching oil forms the oscillating agitator which has an oscillation generating part in the hardening tub which does not become the obstacle of immersion of a processed article, and is performed. In addition, a hardening fixture etc. can be performed by providing said oscillation generating part in a processed article etc.

[0007] Since according to this Claim 1 an effect comparable as a cold oil can be acquired even if

it is a hot oil, the time loss of reduction of the number of times of the clearing work of quenching oil and clearing work can be excluded.

[0008]Claim 2 is the hardening method of said steel according to claim 1, wherein the pitch given to quenching oil is 10–500 Hz. That is, when it is difficult to acquire the chilling effect at the time of hardening when the pitch given to quenching oil is 10 Hz or less and it exceeds 500 Hz, the equipment of a vibration source is enlarged and difficulty follows on practical handling. Like the above, as for the pitch given to quenching oil, for 10–500 Hz is preferred, and it is suitably chosen by the size of a hardening tub within the limits of this.

[0009]Claim 3 is a hardening device of steel, and in order to carry out oscillating stirring of the quenching oil supplied in the hardening tub and this hardening tub, and this quenching oil, it consists of oscillating agitating equipment formed in said hardening tub. That is, what is called the conventional stirring wings do not exist, therefore quenching oil is made to produce a uniform turbulent flow and pressure variation.

[0010]According to this Claim 3, heterogeneous phenomena of the flow of quenching oil, a generating phenomenon of a bubble, etc. which are produced by what is called the conventional stirring wings can be prevented, the uniform hardening of a processed article is possible and improvement in the hardening characteristic is achieved.

[0011]Claim 4 forms two or more said oscillating agitators in a hardening tub. Namely, for example, an oscillating agitator is formed in the both ends of the hardening tub of rectangular shape, or both sides, i.e., the both sides of a processed article. It considers so that oscillating stirring of the quenching oil in a hardening tub may be performed uniformly, and the oscillating stirring force of quenching oil [ as opposed to a processed article according to necessity ] is raised.

[0012]Said oscillating agitator is provided with an oscillation generating part, and Claim 5 makes an oscillation generating part generate 10–500-Hz vibration. According to this Claim 5, according to various processed articles or hardening time, suitable pitch can be chosen and a processed article can be hardened.

[0013]

[Function]According to this invention, a predetermined vibration is given to quenching oil, a uniform turbulent flow arises in quenching oil, and still more uniform pressure variation arises. As a result, cooling of the whole surface of a processed article and quenching are performed uniformly, without receiving influence in the form and the size of a processed article.

[0014]According to this invention, like the above, the number of times of clearing work and the time loss of clearing work can be excluded for the quenching oil aligned with the processed article, therefore the increase in efficiency of hardening can be attained.

[0015]

[Mode for carrying out the invention]Below, the 1 embodiment of this invention is described. One form of enforcement of the hardening device of this invention is shown in drawing 1.

[0016]It is an oscillating agitator with which arrange one to a hardening tub among a figure, 2 has been arranged at quenching oil, and 3 has been arranged at the opposite portion of said hardening tub 1, and it specifically has the oscillation generating part 4, the vibration rod 5, and the vibration blade 6 in which the motor etc. were built in, respectively, and is used, immersing this vibration rod 5 and vibration blade 6 portion in the quenching oil 2.

[0017]The number of the vibration blades 6 provided in the number of install stands and the vibration rod 5 of said oscillating agitator 3 is suitably adjusted with the size of the hardening tub 1, the quantity of a processed article, etc.

[0018]The hardening device of said composition is used and the result of having changed the pitch given to quenching oil and having hardened the processed article (test specimen) is shown below.

[0019]

[Work example 1]

hardening tub: — 1000L X 550W X 500H quenching oil: — a hot oil (trade name high temp A; made by IDEMITSU KOSAN CO. LTD.)

Test specimen :SCN420 (phi25mmX100mm)

Said hardening tub was filled up with said 220 l. of quenching oil, and fluid oscillation equipment (JAPAN TECHNO CO. LTD. alpha2 type) was further installed in the both ends inside a

hardening tub. This fluid oscillation equipment is a thing which transmits vibration generated with the output of a 15–50-Hz low frequency wave to the vibration blade of the multistage type of an abbreviated horizontal state, and makes a fluid generate a high-speed three-dimensional turbulent flow by the vibration. It is characterized by there being no contamination, such as air, since it is not what is depended on shearing force like stirring wings, and there being no generating of a bubble.

[0020] First, said 870 \*\* of test specimens are held in carburization atmosphere for 1 hour, and carburization and diffusion treatment are performed. The test specimen S is set to the ten fixtures T as shown in drawing 2. The size of the fixture T is phi200X285H.

[0021] Like the above, said fluid oscillation equipment was used for the test specimen S produced by carrying out, and it cooled by being immersed in the hardening tub which vibrated quenching oil on the frequency of 30 Hz.

[0022] After said completion of hardening, as shown in drawing 3, a 1-mm portion was cut from 1 mm, center section, and lower end part from the upper surface of said test specimen 10, and the hardness (HRC) of the 1.75-mm point a, the 5-mm point b, and the 9-mm point c was further measured from the center of this test specimen 10. The result is shown in the following table 1. The h value in front is a value computed from the Jominy test result and the Grossman chart.

[Table 1]

Hz	上 部			芯 部			下 部			H 值
	1.75	5	9	1.75	5	9	1.75	5	9	
実 1	30	30	32	28	28	28	30	30	32	0.114
実 2	33	33	34	30	30	29	33	34	35	0.138
実 3	40	32	32	32	29	29	30	32	32	0.127
実 4	50	29	29	30	26	26	28	28	30	0.075
比 1	0	29	29	28	26	26	28	28	28	0.067
比 2		29	30	30	28	28	25	25	26	0.07
比 3		30	32	34	23	28	26	29	31	0.101
比 4		33	36	28	30	32	33	32	36	0.141

[0023]

[Work example 2] The conditions except having changed the frequency of fluid oscillation equipment into 33 Hz are the same as said Embodiment 1.

[0024]

[Work example 3] The conditions except having changed the frequency of fluid oscillation equipment into 40 Hz are the same as that of said Embodiment 1.

[0025]

[Work example 4] The conditions except having changed the frequency of fluid oscillation equipment into 50 Hz are the same as that of said Embodiment 1.

[0026]

[Comparative example 1] Except having changed into the state where fluid oscillation equipment is not operated, it is the same as that of said Embodiment 1. That is, it is a case where it is based on a hot oil.

[0027]

[Comparative example 2] It is the same as that of said Embodiment 1 except having changed into fluid oscillation equipment and having stirred quenching oil in sec in 5 cm /.

[0028]

[Comparative example 3] Except having changed quenching oil into the semi-hot oil (hot-quenching NO58E-3; made by Japan grease incorporated company), it is the same as that of the comparative example 2.

[0029]

[Comparative example 4] Except having changed quenching oil into the cold oil (high speed quenching MP; made by Japan grease incorporated company), it is the same as that of the comparative example 2.

[0030] Even when it hardens by giving vibration to a hot oil according to said table 1, it is checked that a h value equal to the usual cold oil is shown. Therefore, according to the form or the size of the steel type of a processed article, or a processed article, it is not necessary to exchange quenching oil one by one.

[0031]

[Effect of the Invention] According to the method of this invention, even if it is a hot oil, the hardening characteristic comparable as a cold oil can be obtained. Therefore, while being able to exclude the time loss at the time of reduction and clearing work of the number of times of the clearing work of the quenching oil set by the form and the size of a steel type or a processed article, improvement in hardening quality can be further aimed at by uniform cooling.

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## DESCRIPTION OF DRAWINGS

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### [Brief Description of the Drawings]

[Drawing 1] It is an approximate account figure of the hardening device of this invention.

[Drawing 2] It is a perspective view showing the test specimen set state to a fixture.

[Drawing 3] It is a perspective view of a test specimen.

### [Explanations of letters or numerals]

1 Hardening tub

2 Quenching oil

3 Oscillating agitator

4 Oscillation generating part

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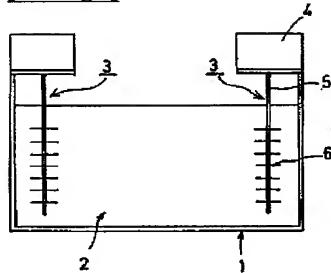
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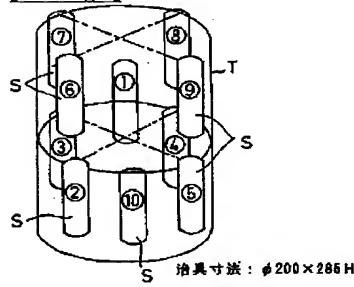
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## DRAWINGS

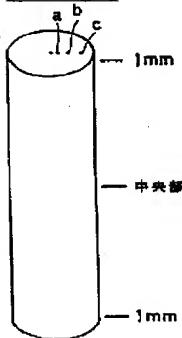
## [Drawing 1]



## [Drawing 2]



## [Drawing 3]



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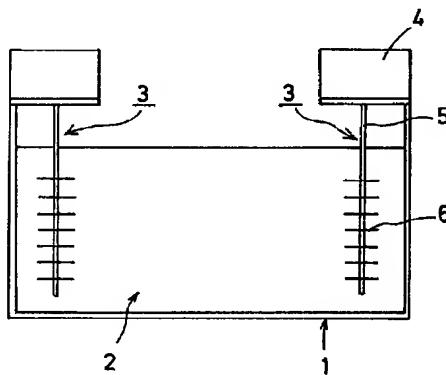
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(54)【発明の名称】 鋼の焼入れ方法及びその装置





	H z	上 部			芯 部			下 部			H 値
		1.75	5	9	1.75	5	9	1.75	5	9	
実 1	30	30	30	32	28	28	28	30	30	32	0.114
実 2	33	33	33	34	30	30	29	33	34	35	0.138
実 3	40	32	32	32	29	29	29	30	32	32	0.127
実 4	50	29	29	30	26	26	26	28	28	30	0.075
比 1	0	29	29	29	26	26	26	28	28	25	0.067
比 2		29	30	30	26	26	25	26	26	26	0.07
比 3		30	32	34	28	28	28	29	31	32	0.101
比 4		33	36	28	30	32	33	32	35	36	0.141

